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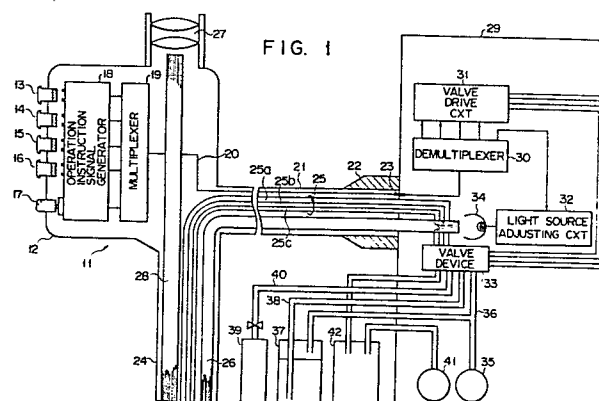
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## 54 Endoscope system.

57 A signal generator (18) is provided on an endoscope (11) for selectively generating an air feed instruction signal, water feed instruction signal, suction instruction signal, air-gas exchange instruction signal and so on. The instruction signal of the signal generator is multiplexed by a multiplexer (19) and sent as one multiplexed signal to a demultiplexer (30) in a light source unit (29) through one transmission path (20). The multiplexed signal is demultiplexed by the demultiplexer and thus a valve device (33) is controlled so as to effect air feed, water feed, suction and air-gas exchange operations.



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Endoscope system

This invention relates to an endoscope system having an endoscope and light source unit.

5 With the conventional endoscope system, operation instructions, such as air feed, water feed and suction instructions, inputted from the control section of the endoscope are transmitted to a light source unit through a connector having a number of connection wires and connection pins, and a pump and valve provided in the  
10 light source unit are controlled by the operation instruction so transmitted. If the number of operation instructions is increased in the conventional endoscope system, the number of connection wires for transmission is increased. As a result, a universal cord between  
15 the control section of the endoscope and the connector becomes thicker and thus the flexibility of the universal cord is lowered, making it difficult to operate the endoscope. If the number of connection wires and connection pins are increased, a complicated  
20 connection is required. Furthermore, the endoscope system becomes bulkier and complicated.

It is accordingly an object of this invention to provide an endoscope system which can transmit a number of operation instruction signals through a lesser number  
25 of transmission paths.

According to this invention there is provided an

endoscope system comprising signal multiplexing means for multiplexing a number of operation instruction signals, a lesser number of transmission paths for transmitting the multiplexed signals to a light source unit, and means disposed in the light source unit to demultiplex the multiplexed signal.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a schematic view showing an endoscope system according to one embodiment of this invention; and

Fig. 2 shows an optical fiber transmission circuit as used in an endoscope system according to another embodiment of this invention.

According to the endoscope system as shown in Fig. 1, a light source light quantity adjustor 17 and operation instruction input switches 13, 14, 15 and 16 for inputting operation instructions for an air feed, water feed, suction and air-gas exchange are disposed in the control section 12 of the endoscope 11. The switches 13 to 16 and adjustor 17 are connected to an operation instruction signal generator 18. The operation instruction signal generator 18 has, for example, a read only memory (ROM) stored with operation instruction information corresponding to the air feed, water feed, suction, air-gas exchange and light adjustment. The output terminals of the operation instruction signal generator 18 are connected to a multiplexer 19. The output terminal of the multiplexer 19 is connected to a connection pin 23 on the forward end of the connector 22 through a transmission path 20 which is provided in the universal cord 21. A bundle of tubes such as an air feed tube 25a, water feed tube 25b and suction tube 25c extends from the connector 22 through a universal cord 21 and insertion cord 24 to the

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distal end (not shown) of an endoscope 11. Likewise, a light guide 26 extends from the the connector 22 to the distal end of the endoscope 11. An image guide 28 extends from the distal end of the endoscope 11 to an eyepiece lens system 27. A demultiplexer 30 is provided in a light source unit 29. The input terminal of the demultiplexer 30 is connected to a transmission path 20 through the connection pin 23 of the connector 22 of the endoscope 11. The output terminals of the demultiplexer 30 are connected to a valve drive circuit 31 and light source adjusting circuit 32. The output terminal of the valve drive circuit 31 is connected to a valve device 33 and light source adjusting circuit 32 is connected to a lamp 34. The inlet of the valve device 33 is connected to an air pump 35 through a pipe 36 and to a water tank 37. The water tank 37 is connected through a pipe 38 to the valve device 33 and a CO<sub>2</sub> gas bomb 39 is connected through a pipe 40 to the valve device 33. A compressor 41 is connected through a tank 42 to the valve device 33. The outlets of the valve device 33 are connected to the tube bundle 25 of the endoscope 11.

In the above-mentioned system, if the air feed switch 13 is closed, an operation instruction signal generator 18 generates an air feed instruction signal which is read out of ROM. The instruction signal, together with a light amount adjusting signal of the light amount adjustor 17, is supplied to the multiplexer 19. The instruction signal and light adjusting signal are multiplexed by the multiplexer 19 and sent to the transmission path 20. The multiplexed signal on the transmission path 20 is supplied through the connection pin 23 to the demultiplexer 30 in the light source unit 29. The signal is demultiplexed by the demultiplexer 30 into the air feed instruction signal and light adjusting signal. The air feed instruction signal is sent to a magnet valve drive circuit 31. The valve drive circuit

31 supplies a valve drive signal to the valve device 33. The valve device 33 connects the air pump 35 to an air feed tube 25a of the tube bundle 25 of the endoscope 11 in response to the valve drive signal, permitting air to be sent into the body cavity of a human being through the air feed tube 25a. On the other hand, the light adjusting signal controls the light source adjusting circuit 32 to permit the lamp 34 to be lit with a predetermined light quantity. When in this state the air-gas exchange switch 16 is closed, an air-gas exchange instruction signal, together with the air feed signal and light adjusting signal, is multiplexed by the multiplexer 19 and transmitted through the transmission path 20 to the demultiplexer 30 of the light source unit 29. The air-gas exchange instruction signal is demultiplexed by the demultiplexer 30 and supplied to the valve drive circuit 31. The valve drive circuit 31 drives the valve device 33 to permit the pipe 40 of the CO<sub>2</sub> gas bomb 39 to be connected to an air feed tube 25a. By so doing, a gas from the CO<sub>2</sub> gas bomb is supplied to the body cavity of a human being. Now suppose that water is supplied. If in this case the switch 14 is closed, a water feed instruction signal is multiplexed by the multiplexer 19 and transmitted to the demultiplexer 30. The valve drive circuit 31 drives the valve device 33 based on the water feed instruction signal to permit the water feed pipe 38 to be connected to the water feed tube 25b of the endoscope 11. The water tank 37 receives a pumping pressure from the pump 35 to cause water in the water tank 37 to be pumped through the pipe 38 and valve 33 to a water feed tube 25b. The water injected in the water feed tube 25b is ejected from the end of the insertion cord and cleans the optical member at the end of the insertion cord. When the suction instruction switch 15 is closed after water injection, a suction instruction

signal is multiplexed by the multiplexer 19 and transmitted through the transmission path 20 to the demultiplexer 30 in the light source unit 29. As a result, the valve device 33 causes the compressor 41 to  
5 be connected to the suction tube 25c of the endoscope 11 to permit water in the body cavity to be sucked. The sucked water enters into the tank 42.

In this embodiment, the instruction signals are converted by a parallel-serial converter to a serial  
10 mode and the serial signals suffer a frequency shift keying (FSK) or is converted to a predetermined frequency signal with the result that it is frequency multiplexed or time-division multiplexed by timing control. The multiplexed signal is transmitted through  
15 one coaxial cable or twisted paired wires. According to this invention, therefore, the instruction signals are multiplexed and many instruction signals can be transmitted through one transmission line. As a result, the diameter of the endoscope can be made thinner  
20 irrespective of the number of instruction signals. For this reason, the flexibility and operability of the endoscope are improved and thus a quick diagnosis can be made on the endoscope without giving greater pain to the patient. A lesser number of transmission lines permits  
25 ready connection and a lesser number of connector pins assures a compact connector. More signals can be transmitted without increasing the number of connector pins. The instruction signals may be analog signals or digital signals or a combination of analog and digital  
30 signals. In this case, the analog signal suffers a V-F conversion or FM modulation whereas the digital signal suffers a frequency shift keying (FSK). If an LSI for data transmission, a one-chip microcomputer etc. are used as a command signal generator and multiplexer,  
35 a control section of the endoscope can be made considerably smaller. As an instruction signal use may

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be made of a code representing the kinds of the  
endoscope. The color temperature of the light source  
and air pressure can be varied according to the kinds of  
endoscopes. A release signal and exposure control  
5 signal from a camera incorporated in the endoscope can  
be multiplexed and sent to the light source unit.

Although in the above-mentioned embodiment a  
connection wire such as a coaxial cable is used as a  
transmission line, an optical fiber transmission may be  
10 used as shown in Fig. 2. That is, instruction signals  
from an instruction signal generator 18 are multiplexed  
by a multiplexer 19 and sent to a light generating unit  
45 including a light-emitting element 45a and a driver  
45b. The light generating unit 45 converts the  
15 multiplexed signal of the multiplexer 19 to a light  
signal. The light signal is transmitted through an  
optical fiber 46 to a light receiving unit 47 including  
a photoelectric converting element 47a and an amplifier  
47b. The output signal of the light receiving unit 47  
20 is supplied to a demultiplexer 30 for demultiplexing.  
The use of such optical fiber transmission permits a  
number of signals to be transmitted at higher density.

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## Claims:

1. An endoscope system comprising:

an endoscope including signal generating means for selectively generating various signals, multiplexing means connected to said signal generating means for multiplexing signals from said signal generating means and a transmission path for transmitting a multiplexed signal from said multiplexing means;

a light source unit including demultiplexing means connected to said transmission path for demultiplexing said multiplexed signal and a controlled unit controlled by the decoded signal of said demultiplexing means.

2. An endoscope system according to claim 1, in which said transmission path is a coaxial cable.

3. An endoscope system according to claim 1, in which said transmission path is optical fiber transmission means.

4. An endoscope system according to claim 1, 2 or 3 in which said signal generating means are selectively generating an air feed instruction signal, water feed instruction signal, suction instruction signal and air-gas exchange instruction signal, and said light source unit includes a valve device for selectively effecting air feed, water feed, suction and air-gas exchange operations in response to instruction signals.

5. An endoscope system comprising:

an endoscope including a light guide for guiding an illumination light, an image guide for conducting a light image, a plurality of tubes, signal generating means for selectively generating various operation instruction signals, multiplexing means for multiplexing the signals of said signal generating means and a transmission path for transmitting a multiplexed signal of said multiplexing means; and

a light source unit including a light source for

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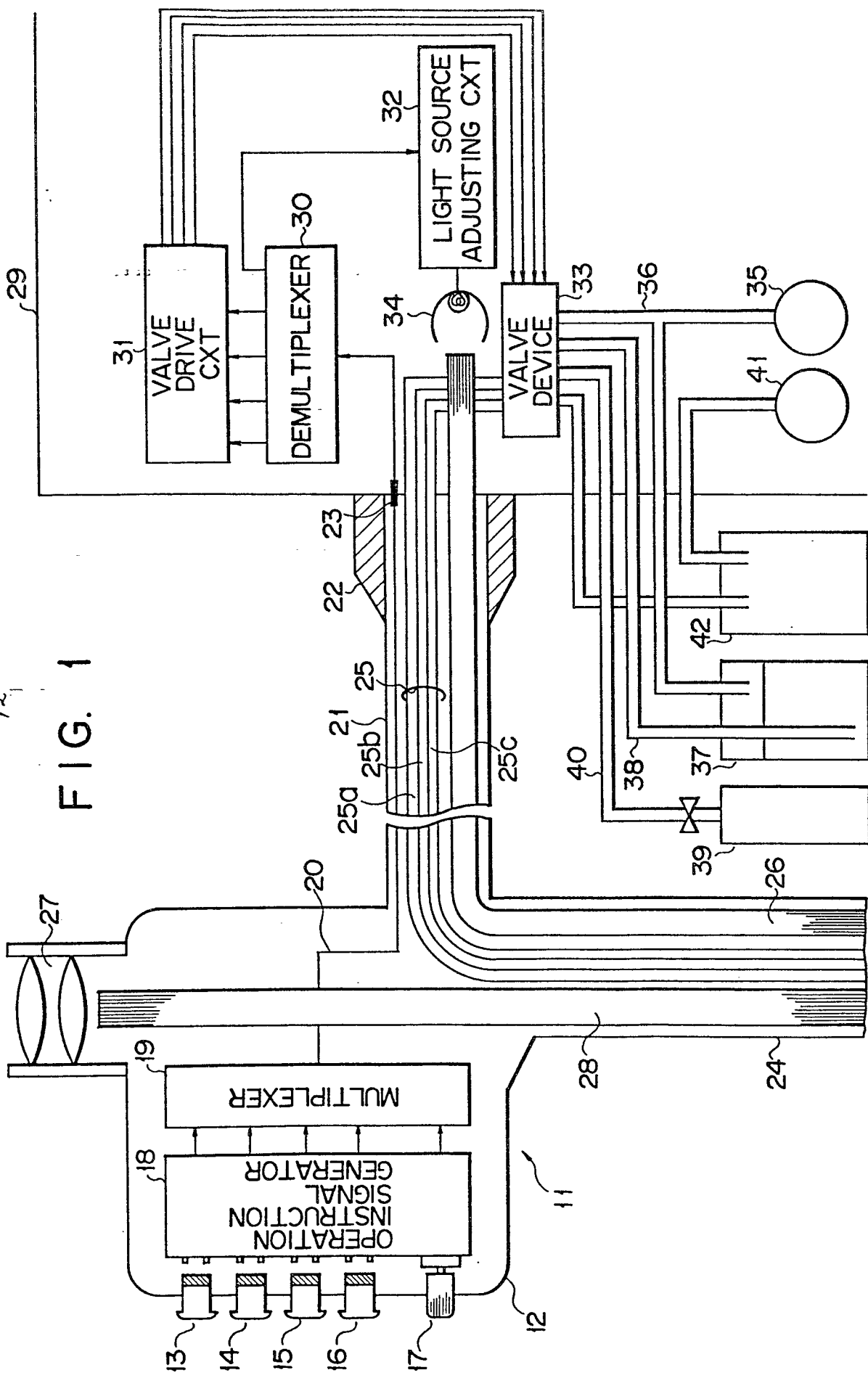
sending the illumination light to the light guide of the endoscope, demultiplexing means for demultiplexing said multiplexed signal, a valve device controlled by the demultiplexed signal of said demultiplexing means for  
5 selectively effecting air feed, water feed, suction and air-gas exchange operation, and means for adjusting the brightness of the light source by the demultiplexed signal.

6. An endoscope system according to claim 5 in  
10 which said transmission path is a coaxial cable.

7. An endoscope system according to claim 5 in which said transmission path is optical fiber transmission means.

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FIG. 1



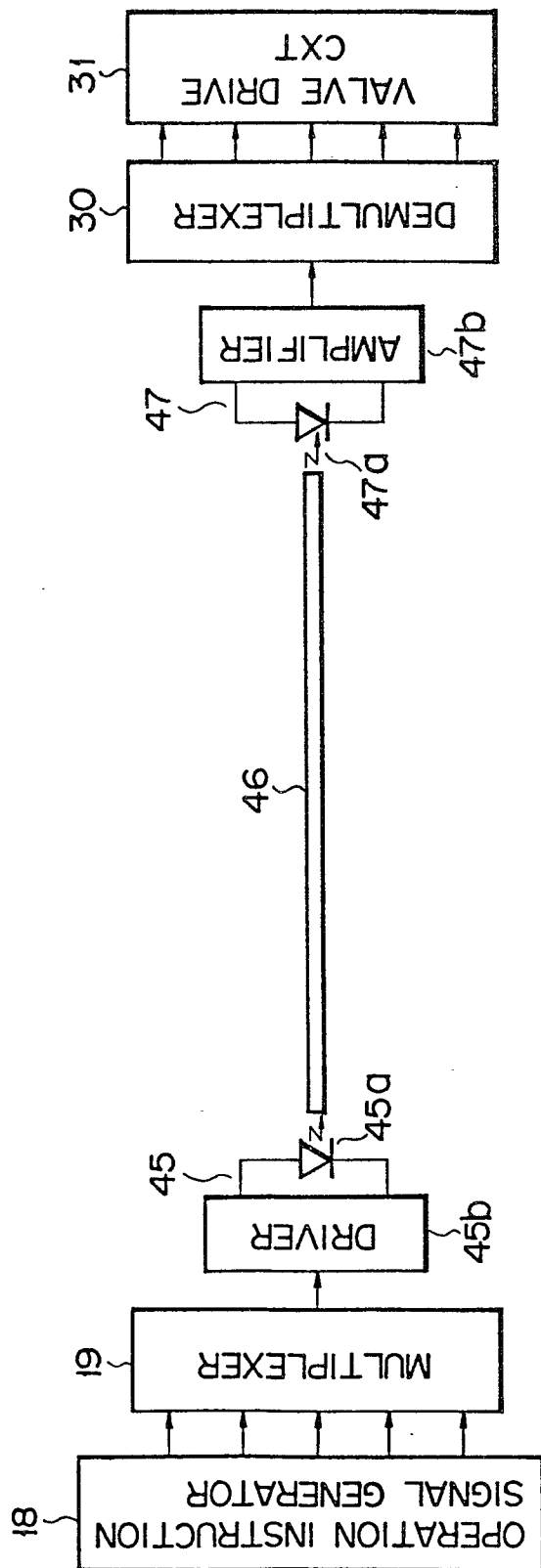


FIG. 2